CLAIMS

The invention is claimed as follows:

1. A method of connecting two tube ends of flexible material, the method comprising the steps of:

directing a laser beam at each of the two tube ends and heating each tube end;

forcing the heated tube ends together;

forming a weld between the tube ends, the weld having weld characteristics; and

comparing the weld characteristics to a weld profile.

2. The method of claim 1, wherein prior to the step of directing a laser beam at each of the two tube ends, the method further comprises the step of:

determining whether the two tube ends are acceptable for connection together.

3. The method of claim 2, wherein the step of determining whether the two tube ends are acceptable for connection together further includes the step of confirming that one tube end is a patient-side tube and the other tube end is a bag-side tube.

4. The method of claim 2, wherein the step of determining whether the two tube ends are acceptable for connection together further includes the step of confirming that one tube end is a patient-side tube and the other tube is a drain bag-side tube.

5. The method of claim 1, wherein the step of directing a laser beam at each of the two tube ends and heating each tube end further includes the step of using an optics assembly to direct the laser beam.

6. The method of claim 1, wherein the step of directing a laser beam at each of the two tube ends and heating each tube end further includes turning off the laser beam after the tube ends are aseptically heated.

7. The method of claim 6, wherein the step of forming a weld between the tube ends further includes energizing the laser unit.

8. The method of claim 1, wherein the step of directing a laser beam at each of the two tube ends and heating each tube end further includes sterilizing the tube ends.

9. The method of claim 1, wherein the step of comparing the weld characteristics to a weld profile further includes determining whether the weld characteristics are at least equal to the weld profile.

10. The method of claim 9, wherein the step of comparing the weld characteristics to a weld profile further includes sealing the tube end between the weld and a patient when the weld characteristics are less than the weld profile.

11. A method of connecting two tube ends of flexible material, the method comprising the steps of:

providing two tube holders, each tube holder receiving one of the two tube ends;

directing a laser beam at the two tube ends to sterilize the two tube ends;

urging the two tube holders together so that the two tube ends contact each other; and

forming a weld between the two tube ends.

12. The method of claim 11, further comprising the step of:

guiding each of the two tube ends across the respective tube holder; and

stopping each tube end a predetermined distance beyond the respective tube holder.

13. The method of claim 11, wherein at least one tube of the two tube ends contains fluid, the method further comprising the step of purging fluid from a portion of the at least one tube.

14. The method of claim 11, wherein the weld has weld characteristics, the method further comprising the step of:

comparing the weld characteristics to a weld profile and determining whether the weld characteristics are at least equal to the weld profile.

15. A device that provides a connection between two flexible tube ends, the device comprising:

a laser unit having a laser beam;

a laser optics assembly capable of changing a direction of the laser beam so that the laser beam strikes the tube ends;

a pair of tube holders each adapted to receive a flexible tube end and adapted to urge the two tube ends together after the two tube ends are aseptically heated via the laser beam, to join the heated tube ends together to form a weld.

16. The device of claim 15, wherein the laser optics assembly includes a prism movably mounted between the two tube ends.

17. The device of claim 15, wherein the laser optics assembly includes a prism and a collimator, the collimator between the laser unit and the prism.

18. The device of claim 15, wherein the laser optics assembly includes a prism, the prism not being positioned between the pair of tube holders.

19. The device of claim 15, wherein the laser optics assembly includes a prism and a light pipe, the prism reflects the laser beam to aseptically heat the tube ends and the light pipe directs the laser beam to weld the two tube ends together.

20. The device of claim 15, wherein the laser beam sterilizes the two tube ends.

21. The device of claim 15, wherein the laser optics assembly changes the direction of the laser beam including a plane of the laser beam.

22. The device of claim 15, wherein the laser optics assembly includes a "Y"-shaped optical component adjacent the laser unit, the "Y"-shaped optical component adapted to split the laser beam and direct the laser beam toward each tube end.

23. The device of claim 22, wherein the laser optics assembly further includes a light pipe component.

24. The device of claim 15, wherein the weld is a hermetic seal.

25. A device for connecting two thermoplastic tube ends together, the device comprising:

two tube holders, each tube holder having an aperture adapted to receive one of the two tube ends;

a laser unit in spaced relation to the tube holders, the laser unit being capable of projecting a laser beam to the two tube ends to sterilize each end and connect the two tube ends together; and

a sensor near the tube holders to analyze the connection between the two tube ends.

26. The device of claim 25, further comprising:

a tracking system connected to the two tube holders and capable of moving the two tube holders together to form a weld between the two tube ends.

27. The device of claim 25, further including an edge detector for sensing the position of each of the two tube ends in the two tube holders.

28. The device of claim 25, further including at least one heat sensor to monitor the temperature near at least one of the two tube ends during the connection process.

29. The device of claim 25, further including an optics assembly to direct the laser beam from the laser unit to the tube ends.

30. A device that provides a sterile connection between two flexible tube ends, the device comprising:

a housing having a back and two slots, each slot adapted to receive one of the flexible tube ends;

a pair of guides positioned within the housing near each slot, each of the guides directs one of the flexible tube ends into the housing;

a laser unit positioned in the housing;

a pair of tube holders positioned within the housing, each of the pair of tube holders adapted to receive the tube end from one of the pair of guides, the tube holders manipulate the flexible tube ends so that each tube end faces the laser unit for heating, bring the heated tube ends together to form a weld, and subsequently release the resulting welded tube.

31. The device of claim 30, further including a sensor in communication with the guides, the sensor triggers the guides to an "on" state when acceptable tube ends are present in each of the slots.

32. The device of claim 31, wherein acceptable tube ends includes one patient-side tube end and one bag-side tube end.

33. The device of claim 32, wherein the sensor further includes an absorption sensor that identifies tube ends that have a dye.

34. The device of claim 30, wherein the sensor triggers each of the pair of guides to an "off" state when the respective tube end projects a predetermined distance beyond its respective tube holder.

35. The device of claims 30, wherein each of the pair of guides crimps the respective tube end and purges fluid from a portion of the respective tube.

36. The device of claim 30, wherein the pair of guides are pinch rollers.

37. The device of claim 30, wherein the pair of guides are threading devices.

38. The device of claim 30, wherein the laser unit sterilizes the tube ends.

39. The device of claim 30, wherein the laser unit is a semiconductor diode laser.

40. The device of claim 30, wherein the laser unit is an Argon laser.

41. The device of claim 30, wherein the laser unit is a CO2 laser.

42. The device of claim 30, wherein the laser unit is a YAG laser.

43. The device of claim 30, wherein each of the pair of tube holders include an aperture having a diameter that is slightly smaller than an outer diameter of the flexible tube.

44. The device of claim 30, wherein each tube holder has a tracking system to rotate the tube holder within the housing.

45. The device of claim 30, wherein the pair of tube holders are synchronized and move simultaneously to manipulate the two flexible tube ends within the housing.

46. The device of claim 30, further comprising at least one sensor to detect temperature near the tube ends and identify predetermined sterilization levels.

47. A method for providing a connection between two thermoplastic tubes, each tube having a sealed end, the method comprising the steps of:

providing a housing adapted to receive the two thermoplastic tubes;

providing a laser unit within the housing;

loading the sealed end of each thermoplastic tube into the housing;

manipulating the thermoplastic tubes within the housing so that each sealed end faces the laser unit;

sterilizing and opening the sealed ends by energizing the laser unit;

manipulating the thermoplastic tubes again so that the now opened ends are aligned with each other; and

welding the two tube ends together via the laser unit.

48. The method of claim 47, wherein the step of loading the sealed end of the thermoplastic tube into the housing further includes the step of:

clamping the thermoplastic tube to prevent flow of fluid near the end of tube.

49. The method of claim 47, wherein the step of manipulating the thermoplastic tubes within the housing so that the sealed end of each thermoplastic tube faces the laser unit further includes the steps of:

receiving each of the thermoplastic tubes in a tube holder; and

rotating each tube holder approximately ninety (90) degrees to confront the laser unit.

50. The method of claim 47, wherein the step of manipulating the thermoplastic tubes within the housing so that each sealed end faces the laser unit

further includes the step of detecting when the sealed end of each thermoplastic tube approximately faces the laser unit.

51. A method of disconnecting a flexible tube, the method comprising the steps of:

compressing the flexible tube at an area along the tube;

striking a laser beam at the compressed area;

sealing the compressed area; and

separating the flexible tube into two tubes, each tube having a sealed end.

52. The method of claim 51, wherein prior to the step of compressing the flexible tube at an area along the tube, the method further comprising the step of:

selecting the area along the flexible tube.

53. The method of claim 51, wherein prior to the step of compressing the flexible tube at an area along the tube, the method further comprising the steps of:

identifying a weld in the flexible tube; and

selecting the area along the flexible tube a predetermined distance from the weld.

54. The method of claim 51, wherein the step of striking the laser beam at the compressed area further includes the step of pinching the flexible tube between a hammer and an anvil.

55. The method of claim 51, wherein the step of striking the laser beam at the compressed area further includes the step of directing the laser beam via a light pipe.

56. The method of claim 51, wherein the step of sealing the compressed area further includes the step of forming a hermetic seal.

57. The method of claim 51, wherein the step of separating the flexible tube into two tubes further includes moving a pair of guides in opposite direction to one another.

58. The method of claim 51, wherein prior to the step of separating the flexible tube into two tubes, the method further comprising the step of cooling the sealed compressed area.

59. A method for providing an aseptic disconnection of a flexible tube, the method comprising the steps of:

providing a housing having an interior section adapted to receive the flexible tube;

providing a laser unit in the interior section of the housing;

selecting an area along the flexible tube;

crimping the area of the flexible tube;

sealing the area via the laser unit; and

separating the tube into two tube segments at the area, each of the tube segments having a sealed end.

60. A device for providing a disconnection of a flexible tube, the device comprising:

a laser unit having an on and off state;

a pair of guides, each guide adapted to receive the flexible tube and move the flexible tube;

a crimping device in between the pair of guides, the crimping device initially compresses the flexible tube while the laser unit is in the off state, the crimping device further pinches and seals the flexible tube when the laser is in the on state; and

the guides move in opposite direction from one another resulting in two sealed segments of flexible tube.

61. The device of claim 60, wherein the two sealed segments are hermetically sealed.

62. The device of claim 60, further comprising a sensor, the sensor locates a preexisting weld along the flexible tube and the guides move the preexisting weld out of alignment with the crimping device.

63. The device of claim 60, further comprising a sensor, the sensor locates a preexisting weld along the flexible tube and selects an area along the tube, in relation to the preexisting weld, the area being the area of disconnection.

64. The device of claim 63, wherein the area is approximately one-eighth inch from the weld toward the patient.

65. The device of claim 60, further comprising a sensor, the sensor determines a location for disconnection in the flexible tube.

66. The device of claim 63, wherein the preexisting weld includes a patient catheter for administering liquid to a patient and the sensor selects the area a predetermined distance from the weld along the patient side tube.

67. The device of claim 60, wherein the pair of guides are pinch rollers.

68. The device of claim 60, wherein the pair of guides are threading devices.

69. The device of claim 60, the device further including a sensor that cooperates with the laser unit, the sensor determines when an acceptable temperature is reached at the selected area.

70. The device of claim 60, wherein the crimping device includes a hammer and an anvil, the flexible tube is positioned between the hammer and the anvil.

71. The device of claim 70, wherein the anvil is a transparent material.

72. The device of claim 60, further including a light pipe to focus a laser beam of the laser unit to an area along the tube to pinch and seal the tube.

73. The device of claim 60, wherein the laser unit is a semiconductor diode laser.

74. The device of claim 60, wherein the laser unit is an Argon laser.

75. The device of claim 60, wherein the laser unit is a CO2 laser.

76. The device of claim 60, wherein the laser unit is a laser diode array.

77 The device of claim 60, wherein the anvil is automatically replaced after a predetermined number of uses.

78. The device of claim 60, further including a protective film on the anvil.

79. The device of claim 78, wherein the protective film automatically advances after every disconnection of a flexible tube.

80. The device of claim 60, wherein the crimping device includes a hammer and an anvil, the device further includes a film on the anvil in between the hammer and anvil.

81. A device for providing a disconnection of a flexible tube, the device comprising:

a housing having a lid;

a hammer;

an anvil aligned with the hammer in the housing, the hammer and the anvil compress the flexible tube;

a laser unit mounted in the housing, the laser unit being energized after the flexible tube is compressed and de-energized after a seal forms in the compressed tube; and

a separator, the separator creates a tension at the seal and splits the flexible tube into two tube segments, each tube segment having a sealed end.

82. The device of claim 81, wherein the separator includes a pair of guides, the guides are adapted to receive the flexible tube and move in opposite direction to one another.

83. A device to connect two flexible tube ends and to disconnect a single flexible tube, the device comprising:

a laser unit having an on and off state, the laser unit emitting a laser beam in the on state;

a laser optics assembly capable of changing a direction of the laser beam;

a pair of tube holders, each tube holder adapted to receive a flexible tube end, the tube ends being aseptically heated via the laser beam, and the tube holders subsequently join the heated tube ends together to form a weld;

a pair of guides, each guide adapted to receive the single flexible tube and move the flexible tube;

a crimping device in between the pair of guides, the crimping device initially compresses a flexible tube while the laser unit is in the off state, the crimping device further pinches and seals the flexible tube when the laser is in the on state; and

the guides move in opposite direction from one another resulting in two sealed segments of flexible tube.

84. A method comprising the steps of:

connecting two flexible tube ends further including striking a laser beam at each of the two tube ends and sterilizing each tube end, forcing the sterilized tube ends together, forming a weld, the weld having weld characteristics, and comparing the weld characteristics to a weld profile; and

disconnecting a flexible tube further including compressing the flexible tube at an area along the tube, striking the laser beam at the compressed area, sealing the compressed area, and separating the flexible tube into two tube segments, each tube segment having a sealed end.

85. A method of providing dialysis treatment to a patient, the method comprising the step of:

sealing a first tube end and a second tube end of medical tubing together via a laser unit.

86. A method of disconnecting a patient from dialysis treatment, the method comprising the step of:

crimping and separating a medical tubing into two tube segments via a laser unit.

87. A device that provides a connection between two flexible tube ends, the device comprising:

a laser unit having a laser beam;

a pair of tube holders each adapted to receive a flexible tube end and adapted to urge the two tube ends together after the two tube ends are heated via the laser beam, to join the heated tube ends together to form a weld; and

a prism not being positioned between the pair of tube holders, the prism capable of changing a direction of the laser beam so that the laser beam strikes the tube ends.

88. A device to connect two flexible tube ends and to disconnect a single flexible tube, the device comprising:

a laser unit having an on and off state, the laser unit emitting a laser beam in the on state;

a laser optics assembly capable of changing a direction of the laser beam;

a film covering a surface of the laser optics assembly, the film capable of advancing after each connection and disconnection;

a pair of tube holders, each tube holder adapted to receive a flexible tube end, the tube ends being aseptically heated via the laser beam, and the tube holders subsequently join the heated tube ends together to form a weld;

a pair of guides, each guide adapted to receive the single flexible tube and move the flexible tube;

a crimping device in between the pair of guides, the crimping device initially compresses a flexible tube while the laser unit is in the off state, the crimping device further pinches and seals the flexible tube when the laser is in the on state; and

the guides move in opposite direction from one another resulting in two sealed segments of flexible tube.